

(3 Hours)

[Total Marks: 80]

- N.B.** (1) Question No. 1 is compulsory  
 (2) Attempt any three out of remaining five questions  
 (3) Assumptions made should be clearly stated

1. (a) Explain post correspondence problem. **5**  
 (b) Differentiate between FA and PDA. **5**  
 (c) Define Regular Expression and obtain a regular expression such that **5**  
 $L(R) = \{ w \mid w \in \{0, 1\}^* \}$  with at the most three zeros  
 (d) What is ambiguous grammar? Check whether following grammar is ambiguous or not **5**  
 $E \rightarrow E + E \mid E * E \mid (E) \mid id$
2. (a) Design a Finite State Machine to accept following language over the alphabet  $\{0, 1\}$  **10**  
 $L(R) = \{ w \mid w \text{ starts with } 0 \text{ and has odd length or starts with } 1 \text{ and has even length} \}$   
 (b) Give and explain formal definition of Pumping Lemma for Regular Language and **10**  
 prove that following language is not regular.  
 $L = \{ 0^i \mid i \text{ is prime number} \}$
3. (a) Construct PDA accepting the language  $L = \{ a^{2^n b^n} \mid n \geq 0 \}$  **10**  
 (b) Consider the following grammar **10**  
 $S \rightarrow i C t S \mid i C t S e S \mid a$   
 $C \rightarrow b$   
 For the string 'ibtaeibta' find the following:  
 (i) Leftmost derivation  
 (ii) Rightmost derivation  
 (iii) Parse tree  
 (iv) Check if above grammar is ambiguous.
4. (a) Construct PDA to check  $\{ cw^r \mid w \in \{a,b\}^* \}$  where  $w^r$  is reverse of  $w$  &  $c$  is a constant. **10**  
 (b) Convert following CFG to CNF **10**  
 $S \rightarrow 0A0 \mid 1B1 \mid BB$   
 $A \rightarrow C$   
 $B \rightarrow S \mid A$   
 $C \rightarrow S \mid \epsilon$
5. (a) Convert  $(0+1)(10)^*(0+1)$  into NFA with  $\epsilon$ -moves and obtain DFA. **10**  
 (b) Construct Moore and Mealy Machine to convert each occurrence of 101 by 111. **10**
6. Write short note on following (any 2) **20**  
 (a) Chomsky Hierarchy  
 (b) Halting Problem  
 (c) Rice's Theorem  
 (e) Universal Turing Machine